FIG.1

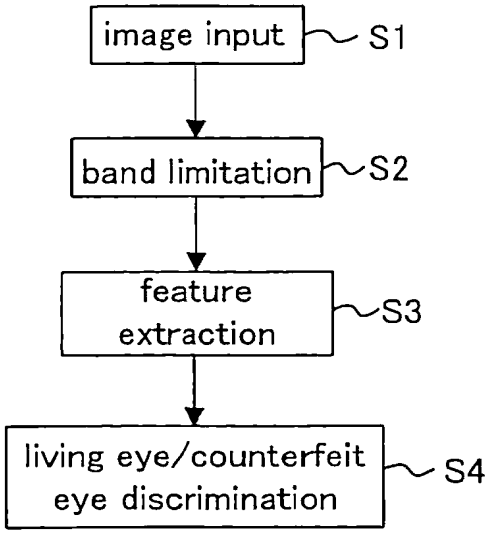
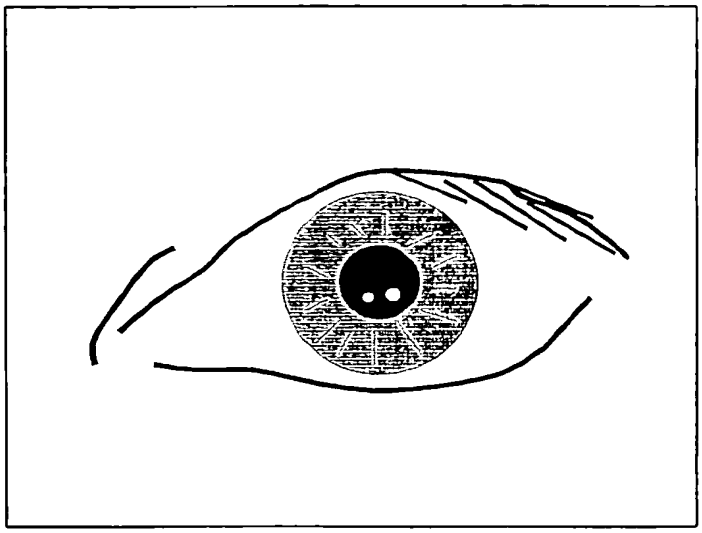
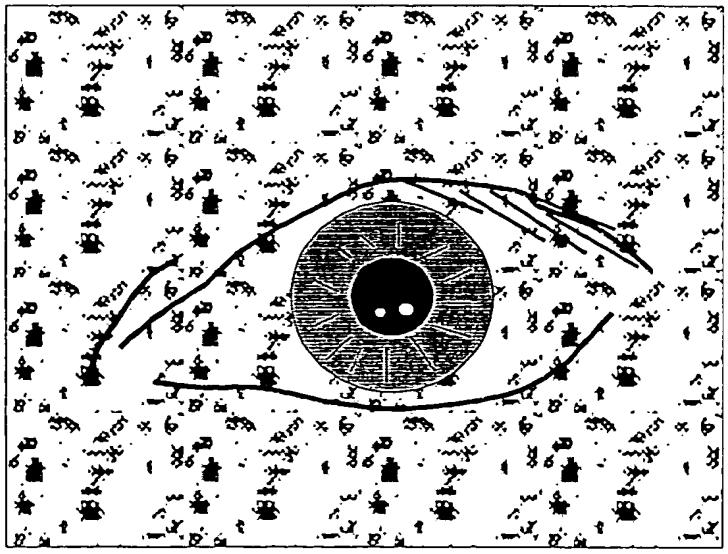



FIG.2



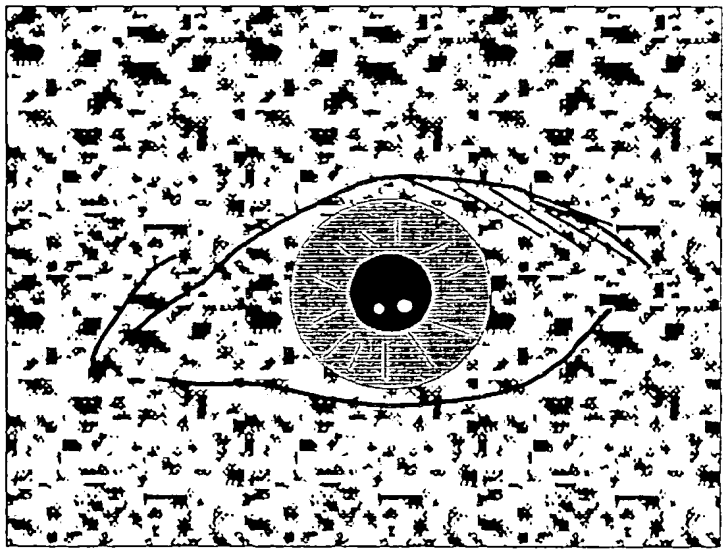
Living eye image

FIG.3



Counterfeit eye image (paper-type 1)

FIG.4



Counterfeit eye image (paper-type 2)

FIG.5

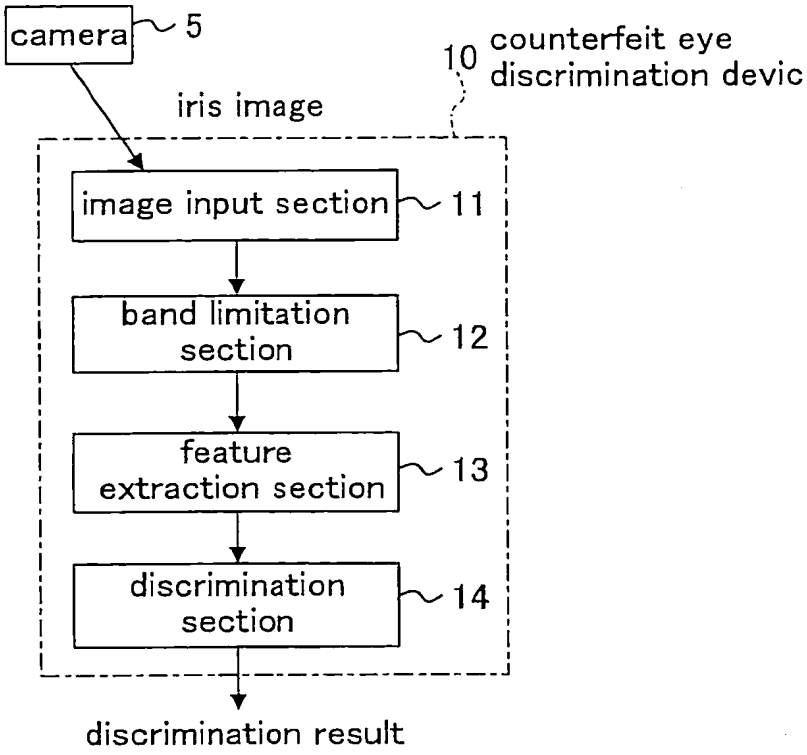
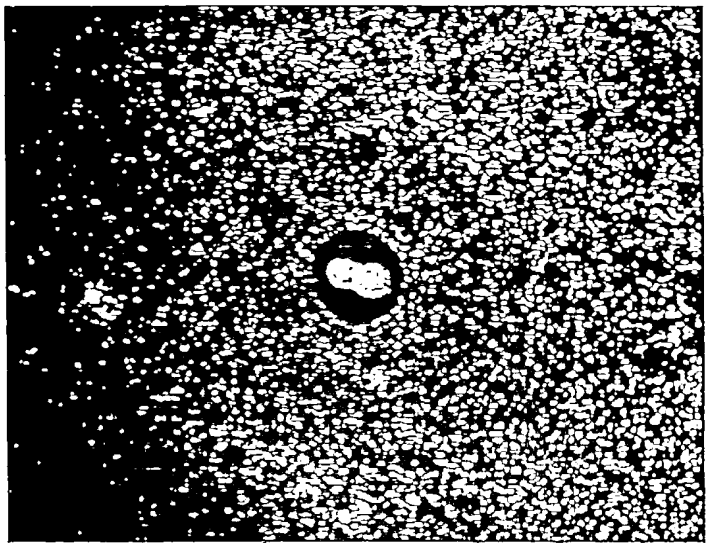
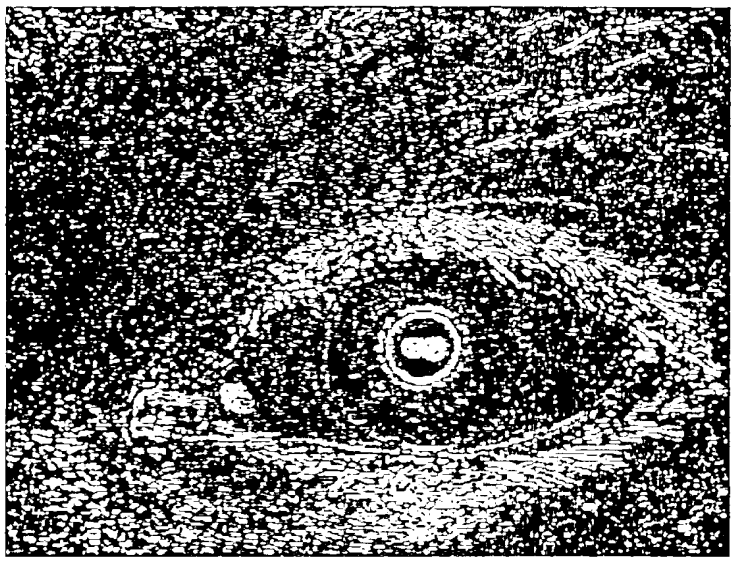



FIG.8



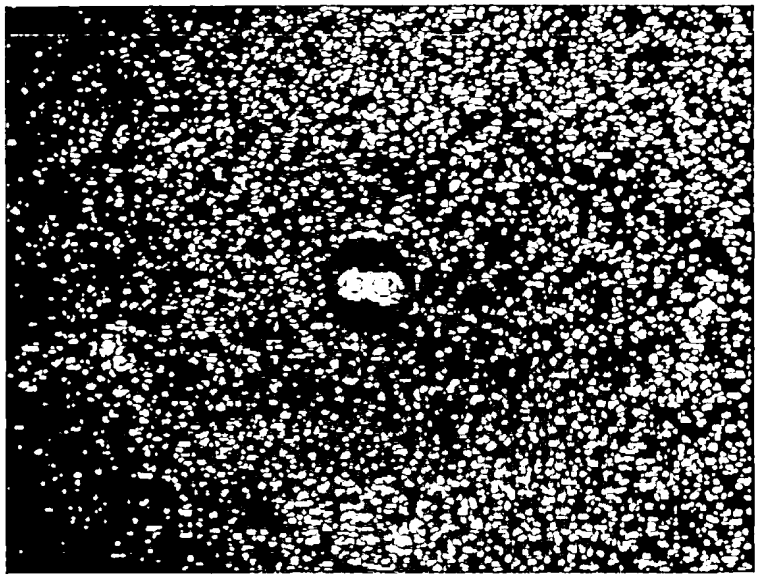
Band-pass filtered output of counterfeit eye image
(paper-type 2)

FIG.6



Band-pass filtered output of living eye image

FIG.7



Band-pass filtered output of counterfeit eye image
(paper-type 1)

FIG.9

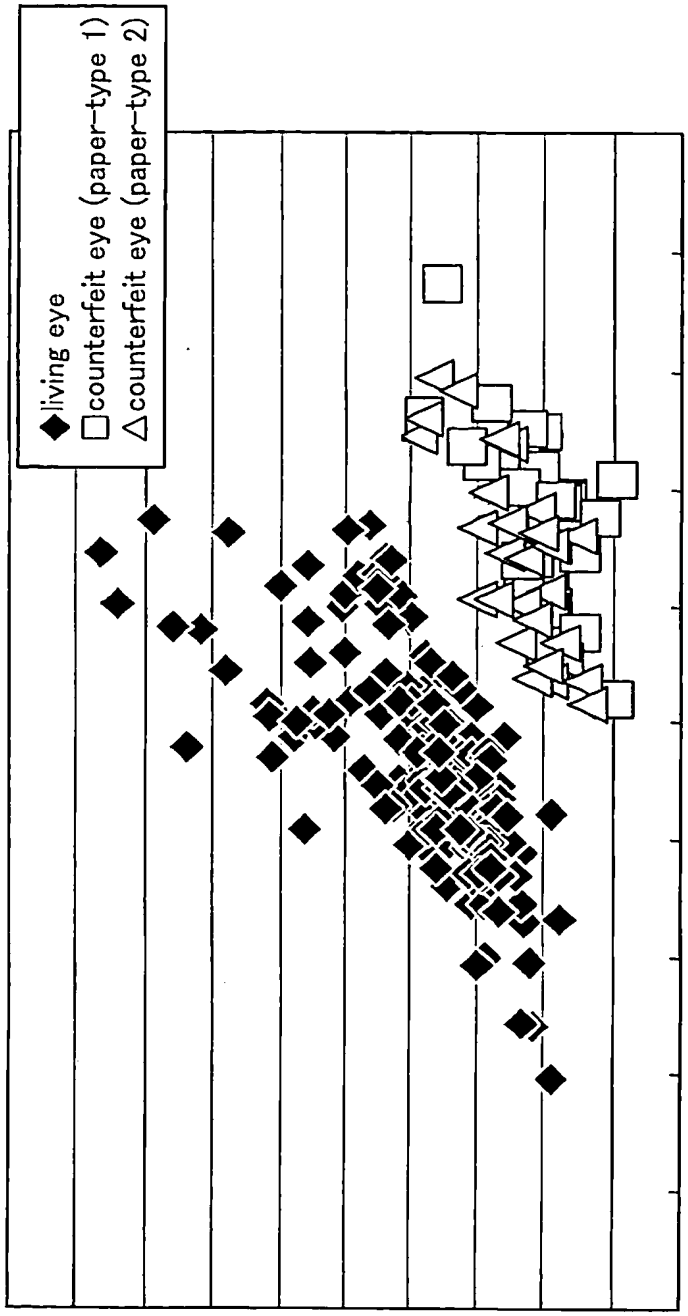

living eye
counterfeit eye (paper-type 1)
counterfeit eye (paper-type 2)
variance of filtered output $\sigma^2$
variation around center of gravity $\frac{\sum_{x,y\in A}\left\{\left(x-x_g\right)^2+\left(y-y_g\right)^2\right\}^2 I(x,y)}{\sum_{x,y\in A} I(x,y)^2}$

FIG.10

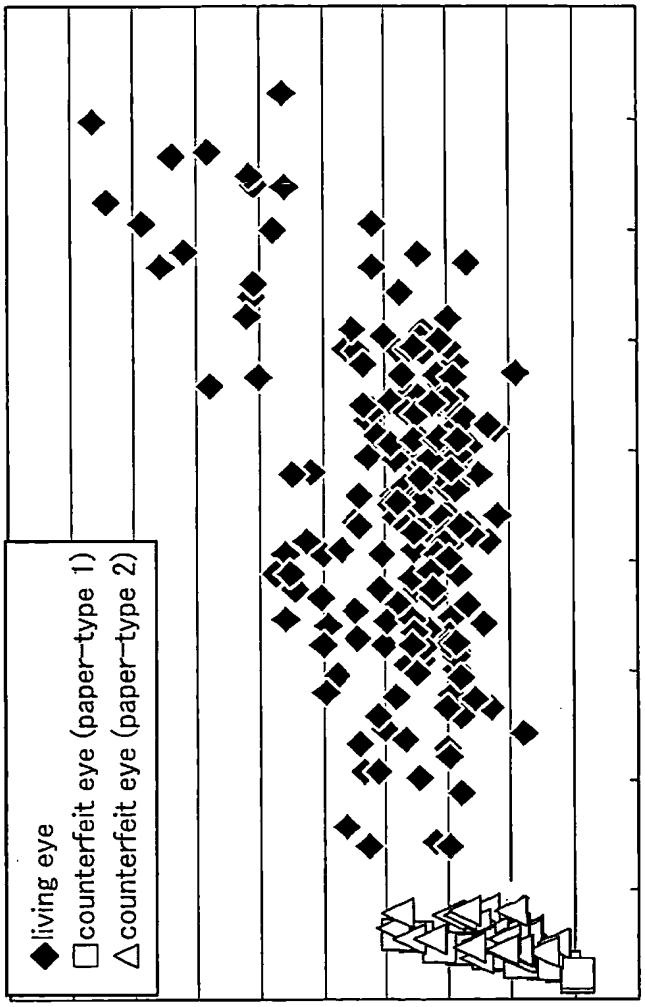

◆living eye
□counterfeit eye (paper-type 1)
△counterfeit eye (paper-type 2)
variance of filtered output $\sigma^2$
mean cube of filtered output $\frac{\sum_{x,y \in A} I(x,y)^3}{N}$

FIG.11

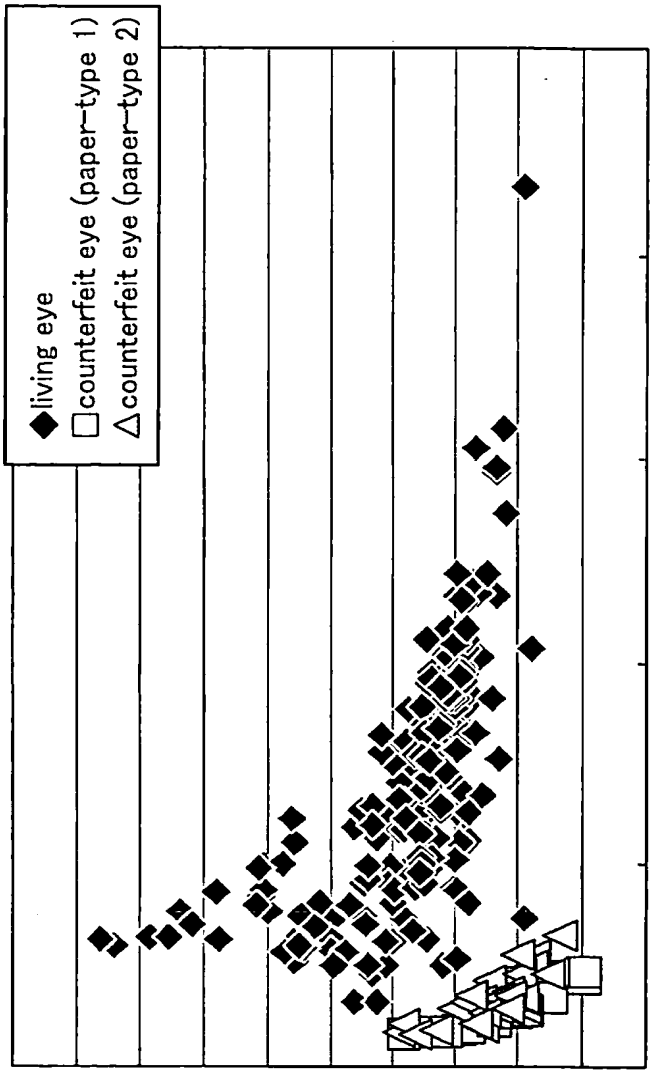

◆living eye
□counterfeit eye (paper-type 1)
△counterfeit eye (paper-type 2)
variance of filtered output $\sigma^2$
skewness of filtered output $S = \frac{\sum_{x,y \in A} \left( I(x,y) - \overline{I(x,y)} \right)^3}{N\sigma^3}$

FIG.12

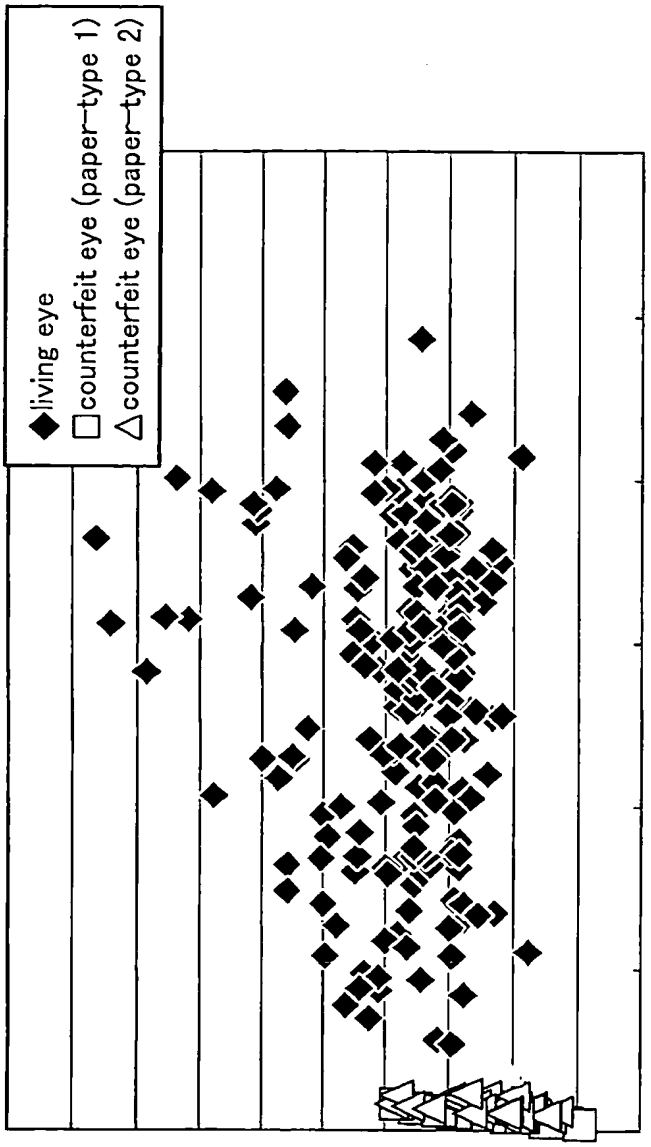

living eye
counterfeit eye (paper-type 1)
counterfeit eye (paper-type 2)
variance of filtered output $\sigma^2$
mean fourth power of filtered output $\frac{\sum_{x,y \in A} I(x,y)^4}{N}$

FIG.13

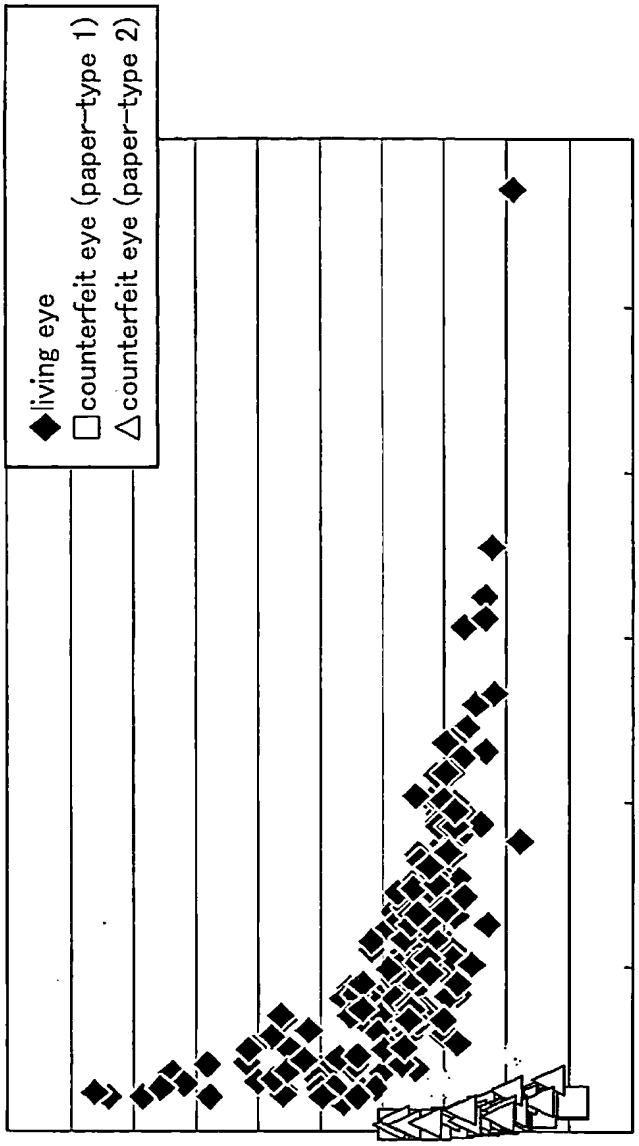

living eye
counterfeit eye (paper-type 1)
counterfeit eye (paper-type 2)
variance of filtered output $\sigma^2$
kurtosis of filtered output
$K = \frac{\sum_{x,y \in A} \left( I(x,y) - \overline{I(x,y)} \right)^4}{N\sigma^4} - 3$

FIG.14

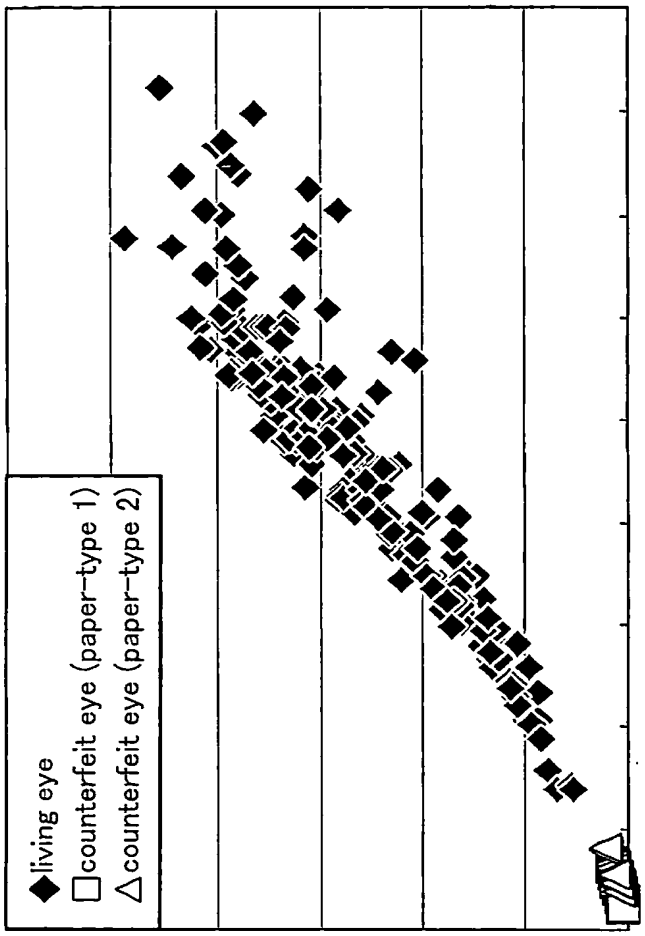

◆living eye
□counterfeit eye (paper-type 1)
△counterfeit eye (paper-type 2)
mean fourth power of filtered output $\frac{\sum_{x,y \in A} I(x,y)^4}{N}$
mean cube of filtered output $\frac{\sum_{x,y \in A} I(x,y)^3}{N}$

FIG.15

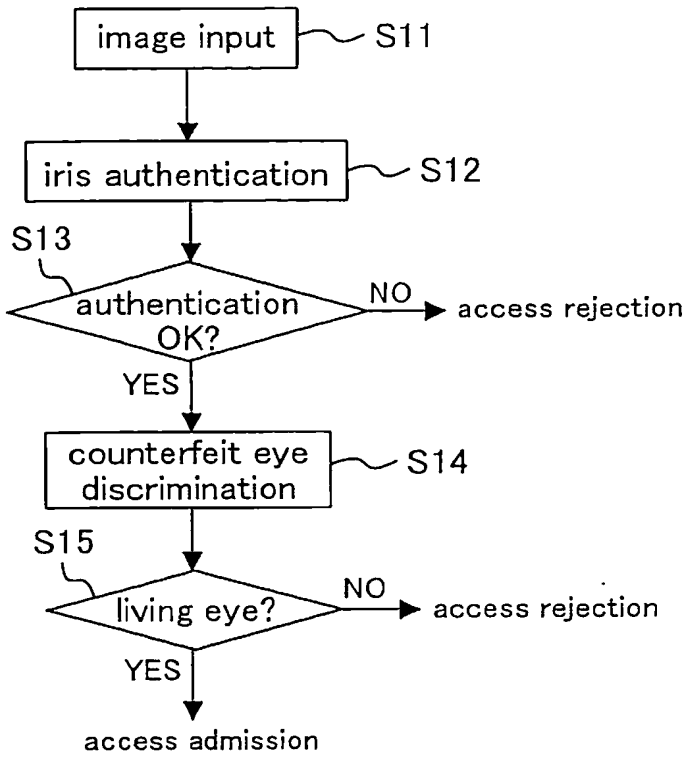
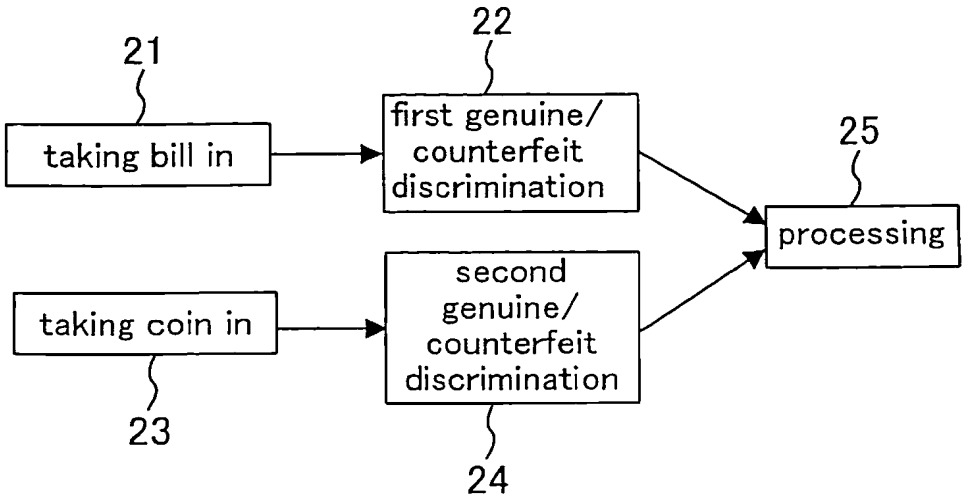


image input
S11
iris authentication
S12
S13
authentication OK?
NO
access rejection
YES
counterfeit eye discrimination
S14
S15
living eye?
NO
access rejection
YES
access admission

FIG.16


21
22
taking bill in
first genuine/ counterfeit discrimination
25
processing
second genuine/ counterfeit discrimination
taking coin in
23
24